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MARGER JOHNSON & MCCOLLOM, P.C.
210 SW MORRISON STREET, SUITE 400
PORTLAND, OR 97204

EXAMINER	
THOMPSON, JAMES A	
ART UNIT	**PAPER NUMBER**
2625	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	03/08/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary

Application No.	Applicant(s)	
09/667,964	DALRYMPLE, JOHN CHARLES	
Examiner	**Art Unit**	
James A. Thompson	2625	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 21 December 2006.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☐ Claim(s) _____ is/are pending in the application.
4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 16 and 18-30 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 21 September 2006 is/are: a)☒ accepted or b)☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a)☐ All b)☐ Some * c)☐ None of:
1.☐ Certified copies of the priority documents have been received.
2.☐ Certified copies of the priority documents have been received in Application No. _____.
3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

1. Applicant's arguments filed 21 December 2006 have been fully considered but they are not persuasive.

Regarding page 7, line 10 to page 8, line 7: Examiner has used more than the single sentence in column 4, line 65 to column 5, line 1 of Brown (USPN 5,835,687) as even a basic reading of the rejection of claim 29 makes clear. Column 4, line 65 to column 5, line 1 of Brown simply demonstrates that the random seed values generated from a random number generator (as taught by column 6, lines 4-13 of Brown) are "multiple different" random seed values. Thus, Examiner stated in the rejection of claim 29 that Brown discloses "generating a set of multiple different (column 4, line 66 to column 5, line 1 of Brown – using separate color planes, and thus separate random seed values) random seed values (column 6, lines 9-13 of Brown) from a random number generator (column 6, lines 4-8 of Brown – hardware/software determining random weights is by definition a random number generator)".

Regarding page 8, lines 8-24: The fact that Brown teaches the use of multiple, separate color planes demonstrates that there are multiple different random seed values since there would be a random seed value for each color plane. Furthermore, Applicant's argument with respect to "impermissible hindsight" is not relevant in response to an anticipation rejection. While Applicant may believe that the limitations are not fully met by the reference, impermissible hindsight has nothing to do with whether the reference anticipates the claim.

With respect to Applicant's argument that Brown does not teach "adjusting the multiple different random seed values independently of any image information such that all of the random seed values are relatively large to increase the likelihood that dots will be printed sooner when a transition occurs between a zero image region and a nonzero image region", Examiner concedes that Brown does not teach each and every word of this particular limitation. However, Examiner notes that the above limitation is a part of the present amendments to the claims, and not a part of the claims as filed immediately prior to the previous office action, mailed 22 August 2006. Accordingly, new prior art rejections, which have been necessitated by the present amendments to the claims, are set forth in detail below.

Regarding page 8, line 28 to page 11, line 2: Applicant's arguments are directed to the present amendments to the claims. Accordingly, the applied prior art has been reconsidered in light of the present amendments and a new prior art search has been performed. New grounds of rejection, which have been necessitated by the present amendments, are set forth in detail below.

Regarding page 11, lines 4-8: All the present claims are rejected over the prior art. The new grounds of rejection have been necessitated by the present amendments to the claims. Accordingly, the present action is made final.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. **Claims 16 and 27-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Brown (US Patent 5,835,687) in view of Lau (US Patent 6,798,537 B1).**

Regarding claim 16: Brown discloses:

- generating a set of multiple (column 4, line 66 to column 5, line 1 of Brown – using separate color planes, and thus separate random seed values) random seed values (column 6, lines 9-13 of Brown) from a random number generator (column 6, lines 4-8 of Brown – hardware/software determining random weights is by definition a random number generator) independently of any image information associated with the array of pixels (column 6, lines 9-19 of Brown – random weights are not selected with respect to image data) for initializing the error buffers (column 6, lines 13-19 of Brown – error buffer is inherent memory used to store the error values) and for use as initial error values when starting an error diffusion operation including generating random seed values associated with a first set of the array of pixels to be printed for a digital image (column 6, lines 9-15 of Brown – random weights have to be generated before any error diffusion of the input image data can actually be performed).
- initializing the error buffers associated with the array of pixels with the set of random seed values that were generated independently of any image infomation associated with the array of pixels prior to starting the error diffusion operation including initializing a first set of the error buffers associated with the first set of the array of pixels to be printed for the digital image with random seed values that were generated independently of any image information and prior to the starting of the error diffusion operation (column 6, lines 9-15 of Brown – random weights have to be

generated before any error diffusion of the input image data can actually be performed; first randomly generated weights thus initialize the error buffers).

Brown does not disclose expressly adjusting each of the random seed values from the random number generator prior to starting the error diffusion operation such that the adjusted random seed values associated with the array of pixels are relatively large, likely to cause a dot to be printed, and increase the likelihood that dots will be printed sooner when a transition occurs between a zero image region and a non-zero image region; that said random seed values used in said initializing are adjusted random seed values; that said error diffusion operation is for reducing startup transients during the error diffusion operation; and that said random seed values were also adjusted prior to starting the error diffusion operation.

Lau discloses adjusting each of the multiple random seed values from a random number generator such that the adjusted random seed values associated with the array of pixels are relatively large, likely to cause a dot to be printed, and increase the likelihood that dots will be printed sooner when a transition occurs between a zero image region and a nonzero image region (column 10, line 65 to column 11, line 9 of Lau). The dots are printed based both on probability and gray level and said probability and printing is adjusted accordingly (column 10, line 65 to column 11, line 9 of Lau). For a transition between a zero image region (and thus with no printed dots) and a nonzero image region, the likelihood that dots will be printed sooner is increased since the probability function causes the dots to be highly dispersed, such as in figure 12 of Lau.

Brown and Lau are combinable because they are from the same field of endeavor, namely digital image data halftoning and error diffusion. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to utilize the green-noise functions taught by Lau to determine the random seed values taught by Brown. Thus, by combination, said random seed values used in said initializing are adjusted random seed values. Since said random seed values used in said initializing are adjusted seed values, then it necessarily follows that said adjusting also occurs prior to starting the error diffusion operation since, if said adjusting does not occur prior to starting the error diffusion operation, then said random seed values used in said initializing would not be adjusted random seed values *as per* the combination of Brown and Lau. Furthermore, since all the positive operating steps are met by the combination of Brown and Lau, said error diffusion operation is for reducing startup transients during the error diffusion operation. The motivation for doing so would have been that a green-noise mask is more tunable than a simple randomization scheme and makes good use of the printers ability to print individual pixels (column 15, lines 8-13 of Lau). Additionally, a suggestion for combining Brown and Lau is that

both address the issue of providing random seed values for operations performed to image pixels. Lau is simply another type of randomization scheme, and could thus be applied to the system of Brown. Therefore, it would have been obvious to combine Lau with Brown to obtain the invention as specified in claim 16.

Regarding claim 27: Brown discloses initializing multiple different error buffers (column 4, line 66 to column 5, line 1 of Brown – different error buffer for each color separation; buffers are inherent computer memory storing random seed values) associated with multiple different pixels in the array with the set of multiple adjusted random seed values prior to starting any error diffusion operations (column 6, lines 9-15 of Brown – random weights have to be generated before any error diffusion of the input image data can actually be performed; first randomly generated weights thus initialize the error buffers).

Further regarding claim 28: Lau discloses loading the random seed values in the error buffers by selecting only the random seed values with relatively large values ("most likely elements") such that all of the adjusted random seed values associated with the array of pixels have relatively large values compared with the other random seed values and initializing the error buffers associated with the array of pixels only with the set of adjusted relatively large random seed values (column 10, line 65 to column 11, line 9 of Lau). The dots are printed based both on probability and gray level and said probability and printing is adjusted accordingly (column 10, line 65 to column 11, line 9 of Lau). The array is initialized with the most likely elements, which are the elements most likely to be turned on, and thus the largest values relative to the other values.

Regarding claim 29: Brown discloses:

- generating a set of multiple different (column 4, line 66 to column 5, line 1 of Brown – using separate color planes, and thus separate random seed values) random seed values (column 6, lines 9-13 of Brown) from a random number generator (column 6, lines 4-8 of Brown – hardware/software determining random weights is by definition a random number generator) independently of any image information associated with the array of pixels (column 6, lines 9-19 of Brown – random weights are not selected with respect to image data) and independently of any error diffusion values associated with any of the pixels (column 6, lines 9-15 of Brown – random weights have to be generated before any error diffusion of the input image data is performed) including generating random seed values associated with a first set of the array of pixels to be printed for a digital image (column 5, lines 1-8 and column 6, lines 9-13 of Brown).
- initializing multiple different error buffers (column 4, line 66 to column 5, line 1 of Brown – different error buffer for each color separation: buffers are inherent computer memory storing

random seed values) for use as an initial set of error values for the array of multiple different pixels prior to starting any error diffusion operations (column 6, lines 9-15 of Brown – random weights have to be generated before any error diffusion of the input image data can actually be performed; first randomly generated weights thus initialize the error buffers).

- initializing the multiple different error buffers associated with the array of multiple different pixels (column 4, line 66 to column 5, line 1 of Brown – different error buffer for each color separation; buffers are inherent computer memory storing random seed values) with the set of multiple different random seed values that were generated independently of any image information associated with the array of pixels prior to conducting any error diffusion operation on any of the multiple pixels (column 6, lines 9-15 of Brown – random weights have to be generated before any error diffusion of the input image data can actually be performed; randomly generated weights thus initialize the error buffers) including initializing a first set of the error buffers associated with the first set of the array of pixels (set associated with first color to be processed) to be printed (column 5, lines 1-8 of Brown) for the digital image with adjusted random seed values (column 6, lines 20-31 of Brown) that were generated independently of any image information and prior to the starting of the error diffusion operation (column 6, lines 9-15 of Brown – random weights have to be generated before any error diffusion of the input image data can actually be performed; first randomly generated weights thus initialize the error buffers).
- using the multiple different random seed values during a subsequent error diffusion operation on the multiple pixels including the first one of the pixels printed in the image (figure 6(66) and column 7, lines 39-49 of Brown).

Lau discloses adjusting the multiple random seed values independently of any image information such that all of the random seed values are relatively large to increase the likelihood that dots will be printed sooner when a transition occurs between a zero image region and a nonzero image region (column 10, lines 9-39 of Lau). The dots are printed based on a probability function that is tiled as a mask over the entire image (column 10, lines 9-39 of Lau). For a transition between a zero image region (and thus with no printed dots) and a nonzero image region, the likelihood that dots will be printed sooner is increased since the probability function causes the dots to be highly dispersed, such as in figure 12 of Lau.

Brown and Lau are combinable because they are from the same field of endeavor, namely digital image data halftoning and error diffusion. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to utilize the green-noise functions taught by Lau to determine the random seed values taught by Brown. The motivation for doing so would have been that a green-noise

mask is more tunable than a simple randomization scheme and makes good use of the printers ability to print individual pixels (column 15, lines 8-13 of Lau). Additionally, a suggestion for combining Brown and Lau is that both address the issue of providing random seed values for operations performed to image pixels. Lau is simply another type of randomization scheme, and could thus be applied to the system of Brown. Therefore, it would have been obvious to combine Lau with Brown to obtain the invention as specified in claim 29.

4. Claims 18-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Brown (US Patent 5,835,687) in view of Lau (US Patent 6,798,537 B1) and Mintzer (US Patent 5,210,602).

Regarding claim 18: Brown discloses:

- generating a first set of random seed values (column 6, lines 4-13 of Brown) used as initial error values for starting an error diffusion process (column 6, lines 4-19 of Brown) for a first color plane (column 4, line 66 to column 5, line 1 of Brown – using separate color planes).
- generating a second set of random seed values (column 6, lines 4-19 of Brown) for a second color plane (column 4, line 66 to column 5, line 1 of Brown – using separate color planes).
- generating a third set of random seed values (column 6, lines 4-19 of Brown) for a third color plane (column 4, line 66 to column 5, line 1 of Brown – using separate color planes).
- generating random seed values (column 6, lines 9-13 of Brown) for each of the first, second and third color planes (column 4, line 66 to column 5, line 1 of Brown) independently of any image information associated with the array of pixels (column 6, lines 9-19 of Brown – random weights are not selected with respect to image data).
- populating error buffers (column 6, lines 13-19 of Brown – error buffer is inherent memory used to store the error values) for each of the color planes with the random set of seed values prior to starting the error diffusion process (column 6, lines 9-15 of Brown – random weights have to be generated before any error diffusion of the input image data can actually be performed: first randomly generated weights thus initialize the error buffers).

Brown does not disclose expressly that the second set of seed values negatively correlates with the first set of random seed values; adjusting each of the random sets of seed values for each of the first, second and third color planes independently of any image information such that all of the random seed values are relatively large to increase the likelihood that dots will be printed sooner when a transition occurs between a zero image region and a nonzero image region; that the random sets of seed values are

adjusted prior to populating the error buffers; and that said error diffusion operation is for reducing startup transients during the error diffusion operation.

Lau discloses adjusting each of the random sets of seed values for each of the first, second and third color planes (column 12, line 65 to column 13, line 5 of Lau – RGB or CMYK is used) such that all of the random seed values are relatively large to increase the likelihood that dots will be printed sooner when a transition occurs between a zero image region and a nonzero image region (column 10, line 65 to column 11, line 9 of Lau). The dots are printed based both on probability and gray level and said probability and printing is adjusted accordingly (column 10, line 65 to column 11, line 9 of Lau). For a transition between a zero image region (and thus with no printed dots) and a nonzero image region, the likelihood that dots will be printed sooner is increased since the probability function causes the dots to be highly dispersed, such as in figure 12 of Lau).

Brown and Lau are combinable because they are from the same field of endeavor, namely digital image data halftoning and error diffusion. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to utilize the green-noise functions taught by Lau to determine the random seed values taught by Brown. Thus, by combination, said random seed values used as initial error values are adjusted random seed values. Since said random seed values used as initial error values are adjusted random seed values, then it necessarily follows that said adjusting also occurs prior to populating the error buffers since, if said adjusting does not occur prior to populating the error buffers, then said random seed values used as initial error values would not be adjusted random seed values *as per* the combination of Brown and Lau. Furthermore, since all the positive operating steps are met by the combination of Brown and Lau, said error diffusion operation is for reducing startup transients during the error diffusion operation. The motivation for doing so would have been that a green-noise mask is more tunable than a simple randomization scheme and makes good use of the printers ability to print individual pixels (column 15, lines 8-13 of Lau). Additionally, a suggestion for combining Brown and Lau is that both address the issue of providing random seed values for operations performed to image pixels. Lau is simply another type of randomization scheme, and could thus be applied to the system of Brown. Therefore, it would have been obvious to combine Lau with Brown.

Brown in view of Lau does not disclose expressly that the second set of seed values negatively correlates with the first set of random seed values.

Mintzer discloses generating a second set of random seed values (figure 2b($c_{r,s}^{c2}$); figure 3 (random number generator); and column 7, lines 32-42 of Mintzer) so as to negatively correlate the second set of random seed values with the first set of random seed values for a second color plane

(column 7, lines 14-26 of Mintzer). The color-coupled error diffusion is performed for the red color plane so as to minimize the difference between the green and red input values and the green and red output values (column 7, lines 14-26 of Mintzer). Thus, the set of random seed values for the red color plane is negatively correlated with the set of random seed values for the green color plane since, if the green input is too high, then the red input must be correspondingly low in order to minimize the difference between the combination red and green input and the combination red and green output.

Brown in view of Lau is combinable with Mintzer because they are from the same field of endeavor, namely digital image data halftoning and error diffusion. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to negatively couple the second set of random seed values with the first set of random seed values, as taught by Mintzer. The motivation for doing so would have been to provide an improved color reproduction in a color output system (column 3, lines 7-12 of Mintzer). Therefore, it would have been obvious to combine Mintzer with Brown in view of Lau to obtain the invention as specified in claim 18.

Regarding claim 19: Brown discloses generating at least one set of seed values from a first constant (column 6, lines 51-56 of Brown).

Further regarding claim 20: Mintzer discloses generating a second set of seed values from a second constant (figure 2b($c_{r,s}^{c2}$); figure 3(random number generator); and column 7, lines 32-42 of Mintzer) and then altering the seed values to negatively correlate to the first set (column 7, lines 14-26 of Mintzer). As set forth above, the color-coupled error diffusion is performed for the red color plane so as to minimize the difference between the green and red input values and the green and red output values (column 7, lines 14-26 of Mintzer). Thus, the set of seed values for the red color plane is negatively correlated with the set of seed values for the green color plane since, if the green input is too high, then the red input must be correspondingly low in order to minimize the difference between the combination red and green input and the combination red and green output.

Further regarding claim 21: Mintzer discloses generating a third set of seed values from a third constant (figure 2c($c_{r,s}^{c3}$) of Mintzer) different from the first and second constants (figure 3 (random number generator); and column 7, lines 32-42 of Mintzer).

Regarding claim 22: Brown in view of Lau does not disclose expressly performing a negative correlation from the first set of seed values to form the second set of seed values.

Mintzer discloses performing a negative correlation from the first set of seed values to form the second set of seed values (column 7, lines 14-26 of Mintzer). The color-coupled error diffusion is performed for the red color plane so as to minimize the difference between the green and red input values

and the green and red output values (column 7, lines 14-26 of Mintzer). Thus, the set of random seed values for the red color plane is negatively correlated with the set of random seed values for the green color plane since, if the green input is too high, then the red input must be correspondingly low in order to minimize the difference between the combination red and green input and the combination red and green output.

Brown in view of Lau is combinable with Mintzer because they are from the same field of endeavor, namely digital image data halftoning and error diffusion. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to perform error diffusion for the three color planes, wherein the random seed values of the second color plane negatively correlate with the random seed values of the first color plane as taught by Mintzer. The motivation for doing so would have been to provide an improved color reproduction in a color output system (column 3, lines 7-12 of Mintzer). Therefore, it would have been obvious to combine Mintzer with Brown in view of Lau to obtain the invention as specified in claim 22.

5. Claim 23 is rejected under 35 U.S.C. 103(a) as being unpatentable over Brown (US Patent 5,835,687) in view of Lau (US Patent 6,798,537 B1), Mintzer (US Patent 5,210,602), and obvious engineering design choice.

Regarding claim 23: Mintzer discloses performing a negative correlation from the first set of seed values to form the second set of seed values, as discussed in the arguments regarding claim 22 presented above.

Brown in view of Lau and Mintzer does not disclose expressly multiplying the first set of seed values by a negative number to form the second set of seed values.

However, it would have been an obvious engineering design choice for one of ordinary skill in the art at the time of the invention to multiply the first set of seed values by a negative number to form the second set of seed values, thus negatively correlating the first set of seed values with the second set of seed values. The motivation for doing so would have been that multiplying by a negative number is computationally simple and requires the least cpu time compared with operations such as multiplication or division. Furthermore, simply using the negative values of the first set of seed values as the second set of seed values will help to minimize the difference between the combination of green and red input values and the combination of green and red output values (column 7, lines 22-26 of Mintzer). Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the system of

Brown in view of Lau and Mintzer in the above obvious manner to obtain the invention as specified in claim 23.

6. **Claims 24, 26 and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shiau (US Patent 5,880,857) in view of Lau (US Patent 6,798,537 B1), Mintzer (US Patent 5,210,602), and Levien (US Patent 5,276,535).**

Regarding claim 24: Shiau discloses:

- generating two separate numbers for the purpose of forming a distribution (figure 17 and column 5, lines 41-49 of Shiau)
- generating a first distribution variable from the two numbers (figure 17 and column 5, lines 40-49 of Shiau).
- generating a first set of seed values (column 3, lines 62-66 of Shiau) from the first distribution variable (column 5, lines 62-66 of Shiau) for use as initial error values (column 4, lines 29-38 of Shiau) for starting up an error diffusion process (column 4, lines 38-45 of Shiau).
- initializing the error values with the first set of selected seed values (column 4, lines 29-38 of Shiau) prior to starting the error diffusion operation (column 4, lines 38-45 of Shiau).

Shiau does not disclose expressly that said two separate numbers are independently generated random numbers from a random number generator; that said first distribution variable is specifically a normally distributed variable; generating a second normally distributed variable from the two random numbers that is negatively correlated with the first normally distributed variable; generating a second set of seed values for using as initial error values for starting up the error diffusion process from the second normally distributed variable; generating a third normally distributed variable from the two random numbers that is negatively correlated with the first normally distributed variable and the second normally distributed variable; generating a third set of seed values for using as initial error values for starting up the error diffusion process from the third normally distributed variable; that said initializing is performed with respect to the first, second and third set of selected seed values; adjusting each of the first, second and third sets of seed values prior to starting up the error diffusion process; and that said initializing is specifically performed with respect to error buffers.

Lau discloses separately generating two random number from a random number generator for the purpose of forming a distribution (column 4, lines 30-39 of Lau); and adjusting each of the first, second and third sets of seed values (column 10, line 40 to column 11, line 9 of Lau).

Shiau and Lau are combinable because they are from the same field of endeavor, namely digital image data halftoning and error diffusion. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use two independently generated random numbers to form the distribution used by Shiau, and to adjust each of the first, second and third sets of seed values. Since the first, second and third sets of seed values are used to initialize the error buffers prior to starting the error diffusion process, as taught by Shiau, then the adjustment of the first, second and third sets of seed values must also occur prior to starting up the error diffusion process. The motivation for doing so would have been to form an aperiodic pattern (column 4, lines 30-33 of Lau), which mitigates problems associated with using periodic patterns, such as Moiré (column 1, lines 39-46 of Lau). Furthermore, the use of a green-noise mask for each color is advantageous since a green-noise mask is more tunable than a simple randomization scheme and makes good use of the printers ability to print individual pixels (column 15, lines 8-13 of Lau). Therefore, it would have been obvious to combine Lau with Shiau.

Shiau in view of Lau does not disclose expressly that said first distribution variable is specifically a normally distributed variable; generating a second normally distributed variable from the two random numbers that is negatively correlated with the first normally distributed variable; generating a second set of seed values for using as initial error values for starting up the error diffusion process from the second normally distributed variable; generating a third normally distributed variable from the two random numbers that is negatively correlated with the first normally distributed variable and the second normally distributed variable; generating a third set of seed values for using as initial error values for starting up the error diffusion process from the third normally distributed variable; that said initializing is performed with respect to the first, second and third set of selected seed values; and that said initializing is specifically performed with respect to error buffers.

<u>Mintzer discloses:</u>

- performing error diffusion for each of a first, second and third color plane (figure 1c and column 4, lines 38-48 of Mintzer).
- generating a first set of seed values for a first color plane (figure 2a($c^{c1}_{r,s}$); figure 3(random number generator); and column 7, lines 32-42 of Mintzer).
- generating a second set of seed values (figure 2b($c^{c2}_{r,s}$); figure 3(random number generator); and column 7, lines 32-42 of Mintzer) that is negatively correlated with the first normally distributed variable (column 7, lines 13-26 of Mintzer).

- generating a third set of seed values (figure 2c($c_{r,s}^{c3}$); figure 3(random number generator); and column 7, lines 32-42 of Mintzer) that is negatively correlated with the first set of seed values and the second set of seed values (column 7, lines 26-30 of Mintzer). The color-coupled error diffusion is performed for the red color plane so as to minimize the difference between the green and red input values and the green and red output values (column 7, lines 14-26 of Mintzer) and for the blue color plane so as to minimize the difference between the sum of green, red and blue inputs and the sum of green, red and blue outputs (column 7, lines 26-30 of Mintzer). Thus, the set of random seed values for the red color plane is negatively correlated with the set of random seed values for the green color plane since, if the green input is too high, then the red input must be correspondingly low in order to minimize the difference between the combination red and green input and the combination red and green output. Furthermore, the set of random seed values for the blue color plane is negatively correlated with the green color plane and the red color plane since, if the combination of green and red input is too high, then the blue input must be correspondingly low in order to minimize the difference between the sum of green, red and blue inputs and the sum of green, red and blue outputs.
- generating the seed values specifically for an error buffer (figure 3(coefficient store) and column 7, lines 31-41 of Mintzer).

Shiau in view of Lau is combinable with Mintzer because they are from the same field of endeavor, namely the generation of random noise for error diffusion processing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to generate a first, second and third set of random seed values for a first, second and third color plane, respectively, wherein the second set of random seed values is negatively correlated with the first set of random seed values and the third set of random seed values is negatively correlated with the first and second sets of random seed values, and perform error diffusion for the three color planes, as taught by Mintzer. Thus, the operations performed for the first distribution variable and the first set of seed values would be performed for a second and third distribution variable and a second and third set of seed values. Therefore, by combination, Shiau in view of Lau and Mintzer teaches genera-ting a second distribution variable from the two random numbers that is negatively correlated with the first distribution variable; generating a second set of seed values for using as initial error values for starting up the error diffusion process from the second distribution variable; generating a third distribution variable from the two random numbers that is negatively correlated with the first distribution variable and the second distribution variable; generating a third set of seed values for using as initial error values for starting up

the error diffusion process from the third distribution variable; and that said initializing is performed with respect to the first, second and third set of selected seed values. The motivation for doing so would have been to provide an improved color reproduction in a color output system (column 3, lines 7-12 of Mintzer). Further, it would have been obvious to a person of ordinary skill in the art at the time of the invention to specifically initialize error buffers with the random sets of seed values, as taught by Mintzer. The suggestion for doing so would have been that, in error diffusion, the quantization error is added to the image data and the thus modified image data is compared with a thresh-old value. Whether the added random number is added directly to the image data as a random number, as taught by Shiau in view of Lau, or as an initial error value, such as the error value taught by Mintzer, the result is the same. In both cases, the image data will have a random number added which will then be compared with a threshold value. If the random number is added as part of the error diffusion process, then the error buffer would be initialized with the random number rather than zero. Therefore, it would have been obvious to combine Mintzer with Shiau in view of Lau.

Shiau in view of Lau and Mintzer does not disclose expressly that said first distribution variable is specifically a normally distributed variable; that said second distribution variable is specifically a normally distributed variable; and that said third distribution variable is specifically a normally distributed variable.

Levien discloses performing error diffusion using a Gaussian (normal) distribution function (column 9, lines 21-27 of Levien).

Shiau in view of Lau and Mintzer is combinable with Levien because they are from the same field of endeavor, namely error diffusion processing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to specifically use a Gaussian distribution (which is also a normal distribution) for the first, second and third distribution variables. Thus, the first, second and third distribution variables are specifically first, second and third normally distributed variables. The suggestion for doing so would have been that a Gaussian distribution is isotropic, and therefore error diffusion is performed in the same manner without respect to the direction of error diffusion (column 9, lines 21-27 of Levien). This is advantageous since using a Gaussian distribution thus prevents the rightward diffusion of errors from being biased over the downward diffusion of errors, and likewise for any other direction in which error diffusion is performed. Therefore, it would have been obvious to combine Levien with Shiau in view of Lau and Mintzer to obtain the invention as specified in claim 24.

Further regarding claim 26: Lau discloses that the first, second and third set of seed values are adjusted by selecting only the seed values with relatively large values with respect to other seed values ("most likely elements") such that all the adjusted seed values have a relatively large value, likely to cause a dot to be printed and increase the likelihood that dots will be printed sooner when a transition occurs between a zero image region and a nonzero image region (column 10, line 65 to column 11, line 9 of Lau). The dots are printed based both on probability and gray level and said probability and printing is adjusted accordingly (column 10, line 65 to column 11, line 9 of Lau). For a transition between a zero image region (and thus with no printed dots) and a nonzero image region, the likelihood that dots will be printed sooner is increased since the probability function causes the dots to be highly dispersed, such as in figure 12 of Lau).

7. **Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shiau (US Patent 5,880,857) in view of Lau (US Patent 6,798,537 B1), Mintzer (US Patent 5,210,602), Levien (US Patent 5,276,535) and obvious engineering design choice.**

Regarding claim 25: As set forth above in the arguments regarding claim 24, Shiau in view of Lau, Mintzer and Levien teach that the second normally distributed variable is negatively correlated with the first normally distributed variable; and the third normally distributed variable is negatively correlated with the first normally distributed variable and the second normally distributed variable. However, Shiau in view of Lau, Mintzer and Levien does not disclose expressly that the first normally distributed variable is generated according to $X_1 = \sqrt{-2\ln R_1}\cos(2\pi R_2)$; the second normally distributed variable is generated according to $X_2 = \sqrt{-2\ln R_1}\cos(2\pi(R_2 - 1/3))$, and the third normally distributed variable is generated according to $X_3 = \sqrt{-2\ln R_1}\cos(2\pi(R_2 + 1/3))$.

However, it would have been an obvious engineering design choice for one of ordinary skill in the art at the time of the invention to generate the first normally distributed variable according to $X_1 = \sqrt{-2\ln R_1}\cos(2\pi R_2)$; generate the second normally distributed variable according to $X_2 = \sqrt{-2\ln R_1}\cos(2\pi(R_2 - 1/3))$, and generate the third normally distributed variable according to $X_3 = \sqrt{-2\ln R_1}\cos(2\pi(R_2 + 1/3))$. As set forth above in the arguments regarding claim 24, Mintzer teaches that the second set of seed values is negatively correlated with the first set of seed values; and the third set of seed values is negatively correlated with the first set of seed values and the second set of seed values. The phase values for the first (0 radians), second (-π/3 radians), and third (π/3 radians) functions

are offset from each other so that $X_1 + X_2 + X_3$ results in

$\sqrt{-2\ln R_1}\left(\cos(2\pi R_2) + \cos(2\pi(R_2 - 1/3)) + \cos(2\pi(R_2 + 1/3))\right) = 0$, which clearly demonstrates that the second set of seed values is negatively correlated with the first set of seed values and the third set of seed values is negatively correlated with the first set of seed values and the second set of seed values. The value $\sqrt{-2\ln R_1}$, which is the magnitude for X_1, X_2 and X_3, is the same and is one of many possible values that can be set for a particular peak in a normal distribution.

Thus, while the specific equations for X_1, X_2 and X_3 have not been explicitly set forth by Shiau, Lau, Mintzer or Levien, setting the random seed values to said equations is simply one of the many possibilities by which one of ordinary skill in the art at the time of the invention would practice the system set forth by Shiau in view of Lau, Mintzer and Levien, and thus a part of the practical implementation of said system. The motivation one of ordinary skill in the art at the time of the invention would have had to use said specific equations would have been to establish a particular normal distribution, thus providing an isotropic distribution, allowing error diffusion to be performed in the same manner without respect to the direction of error diffusion (column 9, lines 21-27 of Levien); and to negatively correlate the three color planes, thus providing an improved color reproduction in a color output system (column 3, lines 7-12 of Mintzer). Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the system of Shiau in view of Lau, Mintzer and Levien in the above obvious manner to obtain the invention as specified in claim 25.

8. **Claim 30 is rejected under 35 U.S.C. 103(a) as being unpatentable over Brown (US Patent 5,835,687) in view of Lau (US Patent 6,798,537 B1) and Nakamura (US Patent 5,339,134).**

Regarding claim 30: Brown discloses loading the multiple different random seed values into the multiple different error buffers (column 4, line 66 to column 5, line 1 of Brown – different error buffer for each color separation; buffers are inherent computer memory storing random seed values) prior to any image printing or error diffusion operations (column 6, lines 9-15 of Brown – random weights have to be generated before any error diffusion of the input image data can actually be performed; first randomly generated weights thus initialize the error buffers).

Brown in view of Lau does not disclose expressly that said loading is performed during a system initialization and power on stage.

Nakamura discloses loading data stored in a buffer during a system initialization and power on stage (column 13, lines 15-19 of Nakamura).

Brown in view of Lau is combinable with Nakamura because they are from the same field of endeavor, namely digital image data processing systems. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to perform the loading taught by Brown during the system initialization and power on stage, as taught by Nakamura. The suggestion for doing so would have been that system initializations/power on stages are for the purpose of setting up the system so that any and all operations can be performed immediately. Since the random seed values taught by Brown are a part of the overall data and elements that need to be initialized, one of ordinary skill in the art at the time of the invention would have recognized that the period of system initialization/power on stage would be the best time to perform the initialization of the error buffers. Therefore, it would have been obvious to combine Nakamura with Brown in view of Lau to obtain the invention as specified in claim 30.

Conclusion

9. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to James A. Thompson whose telephone number is 571-272-7441. The examiner can normally be reached on 8:30AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David K. Moore can be reached on 571-272-7437. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

James A. Thompson
Examiner
Technology Division 2625

JAT
03 March 2007

David Moore

DAVID MOORE
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2600